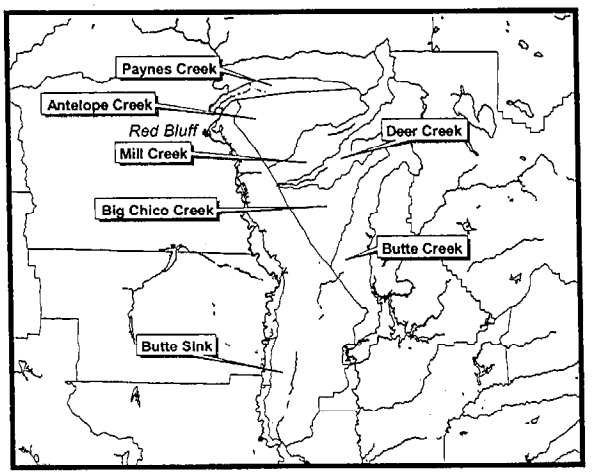
that oversummer in isolated pools in many of the streams.

DESCRIPTION OF THE MANAGEMENT ZONE

The Butte Basin Ecological Management Zone encompasses a significant portion of the Sacramento Valley, east of the Sacramento River and north of the Colusa Basin Ecological Management Zone, and includes the following seven ecological units:

- Paynes Creek Ecological Unit,
- Antelope Creek Ecological Unit,
- Mill Creek Ecological Unit,
- Deer Creek Ecological Unit,
- Big Chico Creek Ecological Unit,



Location Map of the Butte Basin Ecological Management Zone and Units

- Butte Creek Ecological Unit, and
- Butte Sink Ecological Unit.

LIST OF SPECIES TO BENEFIT FROM RESTORATION ACTIONS IN THE BUTTE BASIN ECOLOGICAL MANAGEMENT ZONE

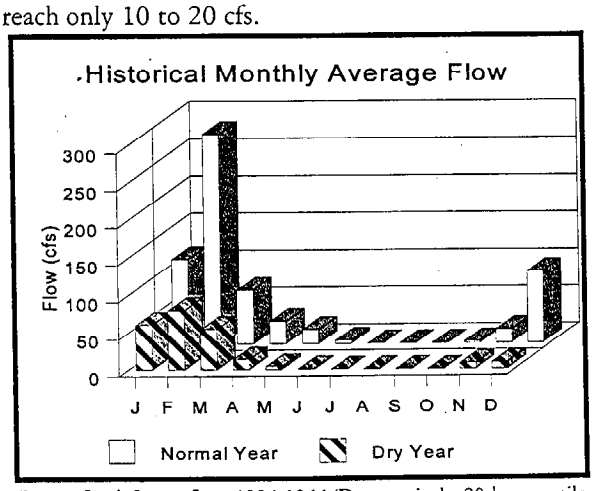
- fall-run chinook salmon
- spring-run chinook salmon
- steelhead trout
- lamprey
- native anuran amphibians
- native resident fishes
- neotropical migratory birds
- giant garter snake
- waterfowl
- plants and plant communities.

DESCRIPTIONS OF ECOLOGICAL MANAGEMENT UNITS

PAYNES CREEK ECOLOGICAL MANAGEMENT UNIT

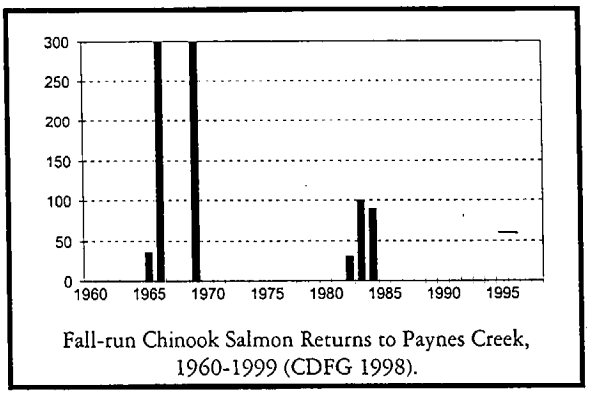
Paynes Creek enters the Sacramento River 5 miles north of Red Bluff. It flows into the Sacramento Valley from the east, draining a watershed of approximately 93 square miles. Paynes Creek originates in a series of small lava springs approximately 6 miles west of the town of Mineral. There are no significant dams on the stream; however, as many as 16 diversions seasonally divert water. Diverted water is used for irrigation, stock watering, and commercial aquaculture. Diversions are confined to the period between late spring and early fall. Significant losses of juveniles can occur in spring if the irrigation season begins when juvenile salmon are attempting to emigrate from the stream into the Sacramento River. Approximately 15 diversions in Paynes Creek need to be screened to protect juvenile fish.

Paynes Creek has a natural flow pattern of high winter and low summer-fall flows, typical of many Sacramento Valley streams that originate in foothills rather than the crests of the Sierra Nevada or Cascade ranges. Low summer and fall flows are further reduced by diversions. The stream is often dry during summer and fall. In wetter years, flows in winter average 200 to 600 cfs. In winter months of dry years, average monthly flows peak at only 50 to 80 cfs. In the driest years, winter monthly average flows reach only 10 to 20 cfs.



Paynes Creek Streamflow, 1956-1966 (Dry year is the 20th percentile year; normal year is the 50th percentile or median year.)

Fall-run chinook salmon and steelhead trout use Paynes Creek when streamflow is sufficient to allow upstream passage. Surveys in the 1960s documented an average run size of 143 fall-run salmon; 300 fish was the maximum run observed in a single season. In most years, rainfall provides sufficient flow for the fall-run chinook salmon to move upstream by late fall.



Fall-run Chinook Salmon Returns to Paynes Creek, 1960-1999 (CDFG 1998).

Riparian and riverine aquatic habitat needs to be improved by providing adequate streamflows and by protecting shorelines from livestock. Vegetation planting may be required in certain areas to hasten and sustain a riparian corridor along the stream.

The size of the salmon run in Paynes Creek is closely linked to rainfall. Therefore, actions to restore and improve conditions for chinook salmon and steelhead are more likely to succeed during periods of normal to above normal rainfall. Limiting water diversions during critical migration periods would help to maintain and improve flows. Reduced diversions could be achieved through voluntary restrictions; direct water purchase; or development of alternative sources, such as wells or storage facilities. Adequate flows are needed in Paynes Creek to provide for the fall adult migration, winter season fry rearing, and spring juvenile outmigration in drier years. Minimum flows in upstream summer rearing areas are needed to sustain steelhead.

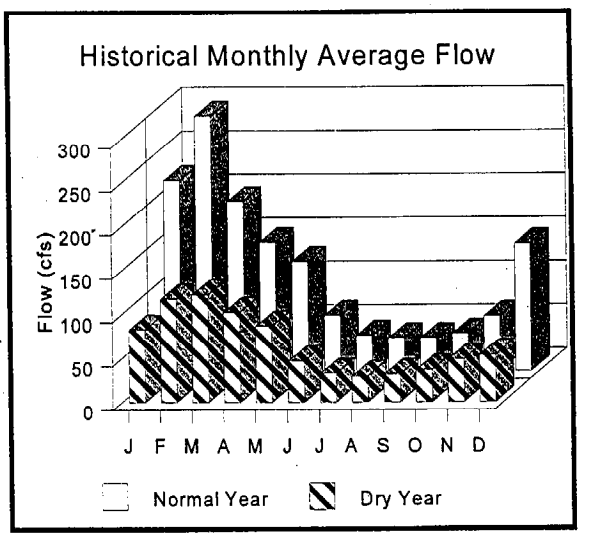
In addition to low flow, inadequate spawning gravel has been identified as a significant factor limiting salmon production. The California Department of Fish and Game (DFG) built five spawning riffles with 1,000 tons of spawning gravel in 1988. Improvement to the sediment supply, including gravel for fish spawning, needs further evaluation.

Restoration and maintenance of Paynes Creek could be improved by establishing a Paynes Creek watershed conservancy. Restoring and maintaining Paynes Creek could be facilitated by developing and implementing a comprehensive watershed management plan.

Antelope Creek Ecological Management Unit

Antelope Creek flows southwest from the Cascade Range foothills and enters the Sacramento River 9 miles southeast of Red Bluff. The drainage is approximately 123 square miles, and the average stream discharge is 107,200 acre-feet (af) per year. Antelope Creek is relatively unaltered above the valley floor, but the seasonal lack of flow to the Sacramento River reduces the creek's potential to produce anadromous fish.

Antelope Creek has a natural streamflow pattern like other nondammed streams in this ecological management zone. Peak flows occur in winter and spring. Lowest flows occur in summer and fall. In wettest years, average flows in winter months range from 200 to 1,200 cfs. In driest years, flows in winter months average below 50 cfs. In all but the wettest years, summer and early fall flows average from 20 to 50 cfs. The natural flow pattern is altered by diversions in the lower creek from spring through fall.



Antelope Creek Streamflow, 1942-1982 (Dry year is the 20th percentile year; normal year is the 50th percentile or median year.)

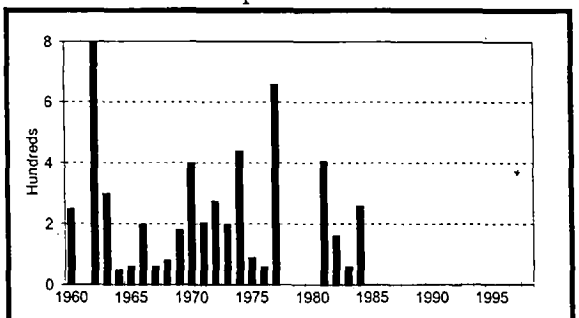
There are two water diversions at the canyon mouth on Antelope Creek. The Edwards Ranch uses water from both diversion points under riparian and pre-

1914 water rights. The Los Molinos Mutual Water Company (LMMWC) shares one diversion with a water right of 70 cfs. Antelope Creek flow is typically diverted from April 1 through October 31. Average flow during this period, measured from 1940 through 1980, was 92 cfs. With water diversion rights exceeding streamflow, the lower reach of the stream is often dry. The seasonal flow needs improvement to permit unobstructed fish passage. To reestablish and increase salmon and steelhead in Antelope Creek, priority must be given to providing and maintaining adequate passage flows from October 1 through June 30 below the Edwards and LMMWC diversion dam. Diversions on Antelope Creek have been screened to protect juvenile salmon and steelhead during their downstream passage.

Migration flows and temperatures adequate to attract salmon must be provided at Antelope Creek's confluence with the Sacramento River. Diversions during the chinook and steelhead migration season should be limited to maintain a flow of at least 25 cfs at the mouth of Antelope Creek. Instream flows should be maintained throughout the irrigation diversion season to provide aquatic habitat and riparian vegetation benefits.

The riparian and riverine aquatic habit along the Antelope Creek corridor needs several improvements. Some areas have been denuded and will require significant revegetation. Woody debris, such as branches and root wads originating from the riparian forest, provides valuable cover for young fish. The riparian zone provides an important migratory corridor for terrestrial species by connecting the mainstem Sacramento River with upper watershed habitats.

Fall- and spring-run chinook salmon and steelhead trout have used Antelope Creek. Population estimates for fall-run salmon on Antelope Creek from 1965 through 1984 ranged from 50 to 4,000, with an average annual run of approximately 467 fish. Historically, an estimated 500 spring-run chinook salmon and approximately 300 steelhead trout annually used Antelope Creek. Since 1986, the California Department of Fish and Game has conducted intensive snorkle surveys on Antelope Creek. Over a period of 12 years, a total of only 19 spring-run chinook salmon have been observed. During 1997, no adult spring-run chinook salmon were observed. This series of observations suggest that Antelope Creek no longer supports a self-sustaining population of chinook salmon. The status of steelhead in Antelope Creek is unknown.



Fall-run Chinook Salmon Returns to Antelope Creek, 1960-1999, (CDFG 1999).

The overall role of Antelope Creek in supporting viable populations of anadromous fish is strongly constrained by flow patterns, flow quantity, high water temperatures, geomorphology of the valley section of the stream, and the steep gradient in the upper reaches.

Insufficient fall flow patterns may delay the upstream migration and spawning of adult fall-run chinook and downstream migration of juvenile spring-run chinook. Likewise, inadequate late spring flows may limit part of the spring-run upstream migration and downstream juvenile fall-run chinook migration. In the lower stream section below the canyon mouth, Antelope Creek is subject to braiding and channel bifurcation, which also impair upstream fish passage.

The Antelope Creek Ecological Unit could be improved by establishing and supporting an Antelope Creek watershed conservancy. Restoring and maintaining Antelope Creek could be improved by developing and implementing a comprehensive watershed management plan. Forest management, including reducing fire fuel loads, would protect riparian habitats and streamflows and help to prevent excessive sediment from being washed into the creek.

Mill Creek Ecological Management Unit

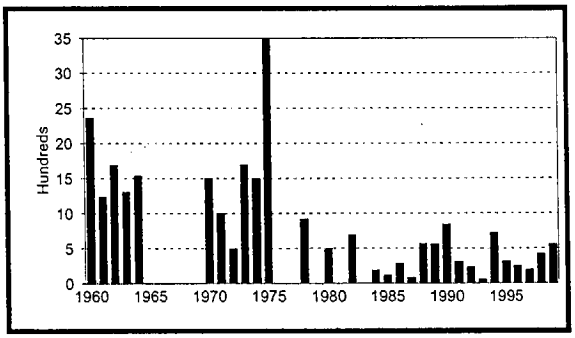
Mill Creek is a major tributary of the Sacramento River, flowing from the southern slopes of Mt. Lassen and entering the Sacramento River at river mile (RM) 230, 1 mile north of the town of Tehama. The stream originates at an elevation of approximately 8,500 feet and descends to 200 feet at its confluence with the Sacramento River. The watershed drains 134 square

miles, and the stream is approximately 65 miles long. The creek is confined within a steep-sided, relatively inaccessible canyon in the upper watershed. Mill Creek spring-run chinook salmon are unique, because they spawn at altitudes above 5,000 feet—the highest altitudes known for salmon spawning in California. The stream flows through the Ishi Wilderness Area and the Gray Davis Dry Creek Reserve, which is managed by The Nature Conservancy. Two dams on the lower 8 miles of the stream divert most of the natural flow for irrigation purposes, usually from May and until September.

Mill Creek has a somewhat atypical seasonal flow pattern. Flows remain relatively high through spring, even in dry years, because of snowmelt and springs on Mt. Lassen. In wettest years, average monthly flows in winter and spring range from 800 to 1,800 cfs. In driest years, flows range only from 60 to 120 cfs. With no storage reservoirs and minimal diversions on the river, streamflows are near natural and unimpeded, except in the valley lowland reach.

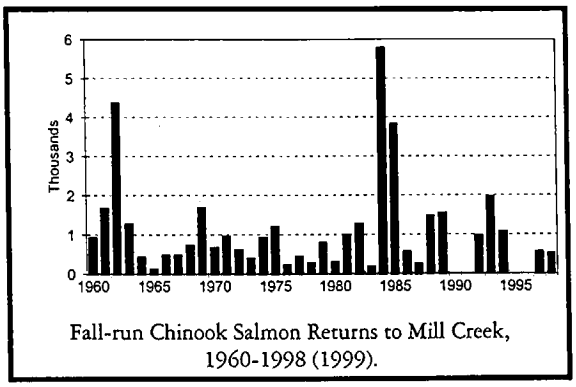
The ecological health of the Mill Creek ecological unit is rated above average due to unimpeded stream flow and the undisturbed quality throughout the holding and spawning habitat of spring-run chinook salmon and steelhead. Populations of spring-run chinook salmon and steelhead have declined sharply in recent years, in large part due to problems outside of the unit.

Spring-run chinook salmon populations in Mill Creek have ranged from a maximum of 3,500 fish to a low of no fish during the severe drought of 1977. During the past decade, annual spring-run chinook populations have averaged 390 fish. More than 2,000 steelhead have been counted at Clough Dam, and steelhead runs averaged 1,100 fish from 1953 to 1965. Anecdotal accounts place the present annual steelhead population at a few hundred fish.



Spring-run Chinook Salmon Returns to Mill Creek, 1960-1999 (CDFG 1999).

Fall-run chinook salmon population estimates have ranged from approximately 6,000 spawners in 1984 to 150 in 1965. The fall run has averaged 2,200 fish for the 38 years of record. Late-fall-run salmon have occasionally been observed spawning in the lower reaches of Mill Creek, but no estimates are available.



Fall-run Chinook Salmon Returns to Mill Creek, 1960-1998 (1999).

Mill Creek differs from other eastside streams because of its high silt load and turbidity during the spring snowmelt period. Recent water quality monitoring for Mill Creek indicates that lands within Lassen Volcanic National Park contribute the major source of silt from the steep barren slopes adjacent to the headwaters. There are insignificant land use activities that occur on the Lassen National Forest lands, however, most of the area is protected by its wilderness designation. The majority of the siltation sources in Mill Creek are the result of natural geologic processes that have existed for thousands of years and are not an impediment to the survival of the endemic anadromous fish populations.

Spawning areas in lower Mill Creek consist primarily of large cobbles and boulders, with very little spawning gravel. Spawning gravel naturally accumulates in the lower reaches of the stream but is flushed from the stream during higher flow events.

Three diversion structures were constructed on Mill Creek in the early 1900s, however, only two are operational. The upper and lower diversions are low structures and have been screened since the 1920s. The Department of Fish and Game has completed several improvements to these structures over the past 50 years including the addition of fish ladders and resloping and refacing the surface of the structures to improve fish passage. These diversion structures are owned and managed by the Los Molinos Mutual Water Company and are regularly

inspected by the Department of Fish and Game to insure optimum fish passage conditions.

The middle diversion structure is known as the Clough Diversion which was constructed in the early 1920s and is privately owned. The structure was screened and has a functional fish ladder. The Clough Dam was breached during the January 1997 flood and presently is not a barrier to fish passage. Alternative designs for reconstructing the dam include options to provide water for irrigation without impairing fish passage.

All of the water diversions have screens, owned by the DFG, in place and in good operating condition.

Sufficient flows permit unobstructed fish passage and cleanse and distribute new spawning gravels. One of the key elements in restoring Mill Creek's salmon and steelhead populations is obtaining dependable flow in the lower stream reaches. A negotiated agreement with the water users is the preferable means of achieving this goal, because it would minimize conflicts between historical land uses and restoration of salmon and steelhead habitat. This has been partially achieved through a cooperative water exchange agreement which has been in place for seven years.

The riparian corridor needs improvement in several areas. Some locations have been denuded and will require significant revegetation.

Gravel spawning habitat in the valley floor section of the creek is not adequate for fall-run chinook salmon. Gravel recruitment is limited because of a relatively low natural supply attributable to the geologic features in the basin. Existing gravel sources may be enhanced to improve spawning areas for fall-run chinook salmon. An evaluation of the potential benefits of providing supplemental gravel into the channel should be completed.

Conservation, restoration, and preservation efforts on Mill Creek have been established by the Mill Creek Conservancy which supports the local approach to watershed management. The local residents, concerned citizens, and resource agencies worked together and prepared the Mill Creek Watershed Management Strategy which is a comprehensive document containing specific recommendation for resource protection.

Restoration activities are presently being implemented in accordance with the priorities stated in the Mill Creek Watershed Management Strategy. The Strategy Report addresses potential stressors including the potential adverse impacts from timber harvesting and additional recreational activities. However, the majority of the upper and middle watershed is protected from detrimental activity due to its Wilderness designation, PACFISH regulations, and private conservation easements.

The majority of the Mill Creek watershed remains undisturbed and is still capable of supporting historic runs of salmon and steelhead. Potential restoration work is concentrated in the lower watershed area on the valley floor that has been impacted by human activities. The major restoration efforts include replanting native riparian vegetation and securing additional instream flows.

Potential timber harvest in the upper watershed threatens loss of holding and spawning areas due to habitat degradation. Selective harvest and well-planned road construction would minimize this effect. Additional recreation areas must be carefully planned and implemented to preserve existing fish habitat. Forest management, including reducing fire fuel loads, will protect riparian habitats and streamflows and help to prevent excessive sediment from being washed into the creek.

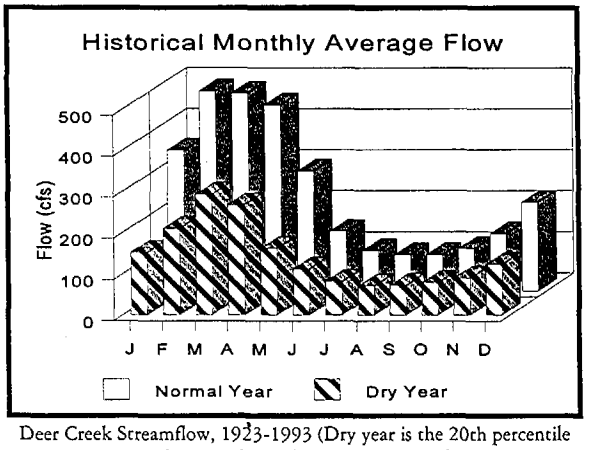
Adult spring-run chinook salmon oversummering in deep upstream pools are susceptible to illegal harvest. The remoteness of the spawning areas contributes to enforcement problems.

DEER CREEK ECOLOGICAL MANAGEMENT UNIT

Deer Creek is a major tributary to the Sacramento River, originating upstream of Deer Creek Meadows on the slopes of Butt Mountain. The creek enters the Sacramento River approximately 1.5 miles north of Woodson Bridge State Park. The watershed drains 200 square miles and is 60 miles long. Part of the upper stream is paralleled by State Highway 32. The lower 10 miles of the creek flow through the valley, where most of the flow is diverted. This lower section encompasses a relatively large flood plain bounded on either side by levees.

In many years prior to 1990, three diversion dams and four diversion ditches depleted all of the natural flow from mid-spring to fall. Since 1990, the local irrigation districts, with assistance from the Departments of Fish and Game and Water Resources, have voluntarily provided fish passage flows at critical times. All of the diversion structures have fish ladders and screens. Of all Sacramento Valley streams, Deer Creek has the greatest potential for restoring spring-run chinook salmon. Overall, the ecological health of the Deer Creek Ecological Management Unit is rated above average. Although spring-run chinook salmon and steelhead populations need to increase in size, the factors limiting these populations lie primarily outside of the unit.

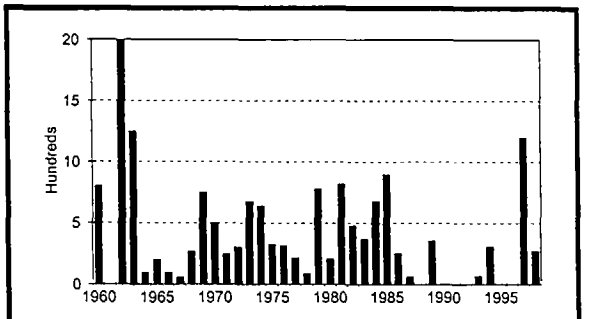
Deer Creek has a seasonal flow pattern similar to that of Mill Creek. Flows are highest in winter and spring, and summer and fall flows. Peak monthly flows in wet winters reach up to 2,600 cfs. In driest years, winter flows reach only 90 to 110 cfs. Minimum summer and fall base flows are 60 to 80 cfs.



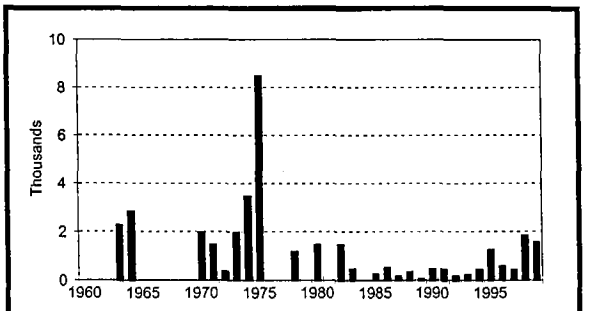
Deer Creek Streamflow, 1923-1993 (Dry year is the 20th percentile year; normal year is the 50th percentile or median year.)

Fall- and spring-run chinook salmon and steelhead trout use Deer Creek. During the past decade, an average of approximately 550 spring-run and 1,000 fall-run chinook have spawned annually in Deer Creek. Habitat in the upper watershed is relatively intact, with numerous holding areas and an abundance of spawning gravel. Some spawning areas in lower Deer Creek are lightly armored and could limit production of fall-run chinook salmon.

Except for the lack of streamflows on the valley floor below the agricultural diversions, fish habitat throughout the drainage is generally of good quality.



Fall-run Chinook Salmon Returns to Deer Creek, 1960-1998 (CDFG 1999).



Spring-run Chinook Salmon Returns to Deer Creek, 1960-1999 (CDFG 1999).

Water right holders on Deer Creek have recently expressed interest in developing alternative water sources for fishery flows. Water users are concerned about the depleted status of the spring-run chinook salmon and have been working toward mutually acceptable solutions to restore the fishery.

Sufficient flows permit unobstructed fish passage and cleanse and distribute new spawning gravels. Inadequate flow for upstream passage is the most significant problem on Deer Creek. Flows necessary to provide unimpaired migration in the lower stream section, for adult salmon and steelhead are undetermined but have been estimated to be 50 cfs at a minimum.

Adequate spawning gravel is found in lower Deer Creek for present population levels of fall-run salmon and existing gravel sources should be protected. Prior to any effort to supplement existing gravel supplies, a comprehensive analysis of stream channel dynamics is required. This study should include elements that address geomorphology, sediment transport flows, stream channel meander, sediment sources, and flood control needs or requirements.

Restoration efforts on Deer Creek will involves the ongoing participation and support of local

landowners through the Deer Creek Conservancy, a local landowners organization. One role of the Deer Creek Conservancy has been the successful development of a cooperative watershed management plan including a watershed management strategy (Deer Creek Watershed Conservancy 1998). Plan formulation is in process and will help to preserve and restore spring-run chinook salmon and steelhead trout and other important attributes of the watershed. The ecological health of Deer Creek could be maintained by developing and implementing a comprehensive watershed management plan.

Additional recreation areas must be carefully planned and implemented to preserve existing fish habitat. Forest management, including reducing fire fuel loads, will protect riparian habitats and streamflows and help to prevent excessive sediment from being washed into the creek.

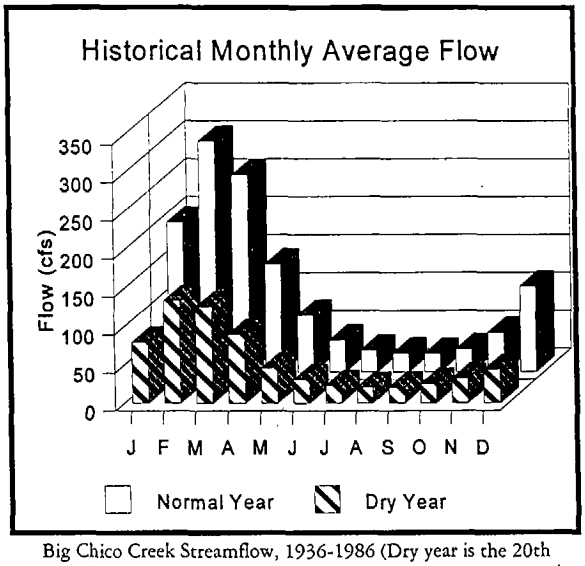
The riparian corridor needs protection and improvement in the lower and upper river. In the lower river, riparian habitat improvements will be coordinated with flood control management activities.

Adult spring-run chinook salmon oversummering in deep upstream pools are susceptible to poaching. The remoteness of the spawning area contributes to enforcement problems.

Big Chico Creek Ecological Management Unit

Big Chico Creek enters the Sacramento River 5 miles west of the City of Chico. It flows into the Sacramento Valley from the Sierra Nevada foothills, draining a watershed of approximately 72 square miles. There are no significant impoundments on the stream, and the only major water diversion has been relocated to the mainstem Sacramento River. The stream is the focal point of the local Chico community. The creek flows through Bidwell Park, downtown Chico, and the Chico State University campus. (Bidwell Park is the third largest city park in the nation.) Lindo Channel is an element of the local flood control system and originates at the Five Mile Recreation Area. The channel returns water to the creek near its mouth below the City of Chico.

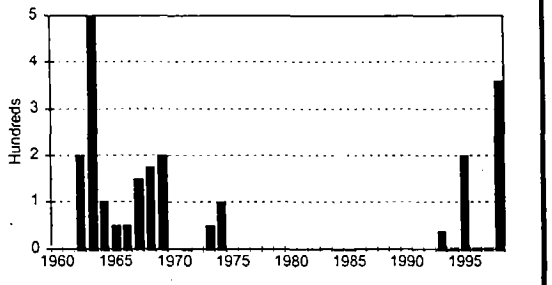
Big Chico Creek has a seasonal flow pattern similar to that of Antelope Creek with moderate winter flows and lower late spring to early fall flow than Mill and Deer Creeks. Peak winter month average flows reach 600-1,500 cfs. In driest years, winter flows reach only 20-40 cfs. Minimum summer and fall base flows are 15-20 cfs in all but the wettest years.



Big Chico Creek Streamflow, 1936-1986 (Dry year is the 20th percentile year; normal year is the 50th percentile or median year.)

Important resources in Big Chico Creek include spring- and fall-run chinook salmon and steelhead trout and resident native fishes. Although spring-run chinook salmon and steelhead populations are very low, factors limiting these population lie primarily outside of the unit. Some improvements in the steelhead trout and spring-run chinook salmon populations can be made if habitat and flows can be restored.

In 1958, the spring-run chinook salmon population was estimated at 1,000 adults, although the average annual run was probably less than one-half this amount during the 1950s and 1960s. In 1995, an estimated 200 spring-run returned to Big Chico Creek, followed in 1998 by 359 spring-run. The 1998 return was likely the progeny of the 1995 return and was assisted by a series of wet years and the relocation of the M&T Pumping Station to the mainstem Sacramento River. Steelhead populations are thought to have averaged approximately 150 returning adults during this same period. Recent estimates indicate a potential to rebuild the spring-run chinook population, a low steelhead population, and a highly variable spawning population of fall-run chinook salmon.



Spring-run Chinook Salmon Returns to Big Chico Creek, 1980-1998 (CDFG 1999).

In addition, adult spring-run chinook are deterred by intermittent flow in Lindo Channel and inadequate fish passage at the One and Five Mile Recreation Areas and at Iron Canyon in upper Bidwell Park. Marginal spawning and rearing habitat in Big Chico Creek and Lindo Channel below the Five Mile Recreation Area is used by fall-run chinook salmon. Big Chico Creek and Lindo Channel are used by many interests for a variety of purposes, including wildlife habitat, anadromous fisheries reproduction and rearing, urban storm drainage, flood control, and recreation.

Functioning in the flood control and recreational pool system, the ecological system supports three salmonid runs. Without careful coordination, successful management of one use may conflict with successful management of another. Even though excellent spawning gravel exists in Lindo Channel, in most years, intermittent flows preclude successful spawning. Big Chico Creek flows for nearly 11 miles through the City of Chico, much of it through Bidwell Park. Vegetation along Big Chico Creek in Bidwell Park is an excellent example of a mature riparian community. Lindo Channel functions as a flood relief channel for Big Chico Creek and supports riparian habitat. Both are surrounded by urban and agricultural uses that could degrade their environmental quality.

Inadequate flow for upstream passage is the most significant problem on Big Chico Creek. During all but the wetter years, flows in fall remain at summer lows. This inhibits and delays the upstream fall-run chinook salmon migration. Water management operations, such as the flow split at Five Mile Diversion Dam, that can improve flows for passage should be evaluated.

Gravel recruitment is limited by existing diversion dams, or gravel is in poor supply from past floods or flood control practices. Existing gravel sources should be protected and supplemental gravel placed into the creek channel as needed.

Restoration efforts on Big Chico Creek will involve the participation and support of local landowners through the Big Chico Creek Task Force, a local organization of stakeholders. The Big Chico Creek Task Force will be instrumental in developing a comprehensive watershed management plan and will assist or sponsor some of the needed restoration elements in the basin. One role of the Big Chico Creek Task Force will be to sponsor the development of a cooperative watershed management plan that will assist in the effort to preserve and restore spring-run chinook salmon and steelhead trout.

The ecological health of the creek could be improved by developing and implementing a comprehensive watershed management plan. Timber harvest in the upper watershed could threaten loss of holding and spawning areas because of habitat degradation. Selective harvest and well-planned road construction may minimize this effect. Additional recreation areas must be carefully planned and implemented to preserve existing fish habitat. Forest management, including reducing fire fuel loads, will protect riparian habitats and streamflows and help to prevent excessive sediment from being washed into the creek.

The riparian corridor needs to be protected and improved in the lower and upper river. In the lower river, riparian habitat improvements will be coordinated with flood control management activities in cooperation with local landowners.

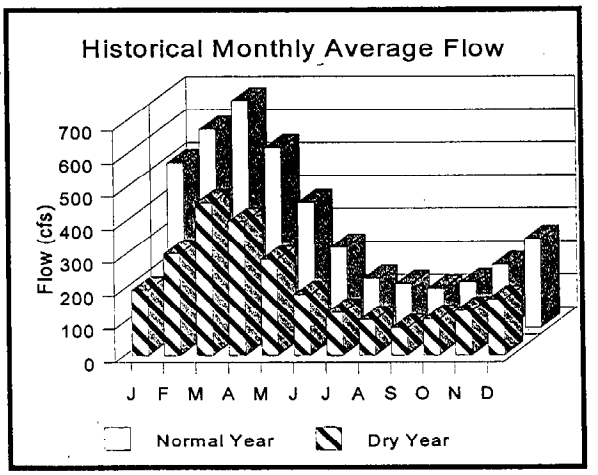
Salmon and steelhead passage problems at Iron Canyon, One-Mile Pool, and Five-Mile Diversion will be improved by repairing weirs and fishways.

Adult spring-run chinook salmon oversummering in deep upstream pools are susceptible to poaching. The remoteness of the spawning areas contributes to enforcement problems. Protect holding pools by obtaining willing seller titles or conservation easements on lands adjoining pools.

BUTTE CREEK ECOLOGICAL MANAGEMENT UNIT

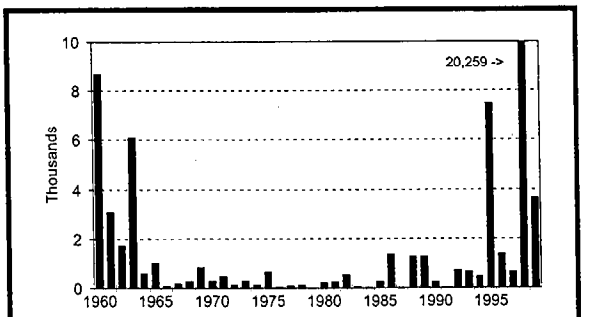
Butte Creek originates in the Jonesville Basin, Lassen National Forest, on the western slope of the Sierra Nevada. It drains the northeastern portion of Butte County. The creek enters the Sacramento Valley southeast of Chico and meanders in a southwesterly direction to the initial point of entry into the Sacramento River at Butte Slough. A second point of entry into the Sacramento River (at lower flows) is through the Sutter Bypass and Sacramento Slough. Butte Creek drains the foothills just south of the Big Chico Creek watershed and North Fork of the Feather River drainage. The upper Butte Creek watershed (northeast of Chico) has an area of approximately 150 square miles. Lower Butte Creek flows parallel to the Sacramento River for almost 50 miles to the Butte Slough outfall. It then continues through the Sutter Bypass and Sacramento Slough channels to join the Feather River near the confluence with the Sacramento River, almost 100 miles downstream of Chico. Butte Slough connects with the Sacramento River through flap gates in the Sacramento River levee. These gates may not be open during the salmon and steelhead migration periods.

Streamflow on Butte Creek is similar to that on Deer Creek, with water from snowmelt and springs to maintain summer and fall flow even in drier years. Peak flow in winter of wet years reaches 1,000 to 3,000 cfs. In driest years, winter flows average only 90 to 120 cfs. Summer and fall minimum flows generally average 120 to 160 cfs but may reach only 50 cfs in driest years.

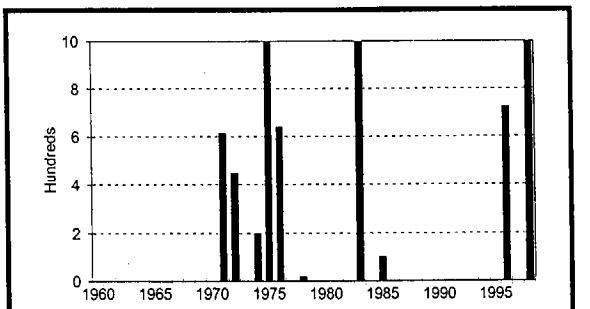


Butte Creek Streamflow, 1963-1993 (Dry year is the 20th percentile year; normal year is the 50th percentile or median year.)

Fall- and spring-run chinook salmon and steelhead trout exist in Butte Creek. As late as the 1960s, Butte Creek supported more than 4,000 adult spring-run chinook salmon, a lesser number of fall-run chinook salmon, and a small number of steelhead trout. More recently, the spring-run chinook populations have ranged from fewer than 200 adults to more than 1,000. Spring-run chinook salmon estimates reached a record of more than 8,000 in 1995, and Butte Creek demonstrated its ability to attract a large spring-run chinook salmon population with adequate streamflows. The fall-run chinook salmon population varies between a few fish to as many as 1,000. The number of steelhead is unknown.



Spring-run Chinook Salmon Returns to Butte Creek, 1960-1999 (CDFG 1999).



Fall-run Chinook Salmon Returns to Butte Creek, 1960-1998 (CDFG 1999).

The decline of Butte Creek's chinook salmon and steelhead populations is attributed to:

- inadequate flows,
- unscreened diversions,
- inadequate passage over diversion dams,
- unblocked agricultural return drains that attract and strand adult fish,
- poor water quality, and
- poaching.

Nine diversion dams on Butte Creek above Butte Slough supply water for power generation, irrigation, gun clubs, and domestic use. All are known to impair and delay migrating fish. One, the Point Four Ranch Dam, was removed in July 1993. Passage at seven of the dams could be improved by either removing the dam or upgrading the ladders. All of the diversions from these dams are unscreened, except the diversion at the Parrott-Phelan Dam, which was recently screened. Presently, three of the seven dams are being removed as part of the Western Canal siphon project, and three others (Durham Mutual, Adams, and Gorrill) have defined projects to build or rebuild ladders and fish screens.

The Centerville Head Dam, immediately below the DeSabla powerhouse, is the upper limit of anadromous fish migration. Water diverted from three adjacent watersheds commingles with the natural flows of Butte Creek and often is the major portion of the flow. Feather River water enters Butte Creek at two locations: via the West Branch into DeSabla Reservoir and through the Thermalito Afterbay and the Western Canal. Flows from both Big and Little Chico Creeks enter Butte Creek from agricultural diversions that empty into Little Butte Creek. Flows from the Sacramento River reach Butte Creek from various diversion points, from as far north as the mouth of Big Chico Creek to the Reclamation District 1004 pumps located near Princeton.

Adult spring-run chinook salmon migrate into Butte Creek during February through June. They oversummer primarily in pools from the confluence of Little Butte Creek to the Centerville Head Dam and begin spawning in late September. Spring-run chinook fry emigrate as early as December, whereas smolts emigrate the following spring. Generally, adequate migration flow exists from Centerville Head Dam downstream to the Western Canal Dam; however, during dry years, several areas above Western Canal may hinder upstream passage. In these dry years, adult spring-run chinook salmon encounter low, warm flows above Western Canal and may become stranded.

Adult fall-run chinook salmon enter lower Butte Creek during late September and early October. Their upstream passage is often blocked by dewatered stream reaches caused by diversions for flooding State and federal refuges and private duck clubs. Below the Western Canal, adult fall-run chinook often encounter impassable barriers, dewatered areas, silt deposition areas, lack of suitable gravel, and inadequate cover and shade. Several barriers exist above the Western Canal that impede the adult migration until high flows occur. Most fall-run chinook salmon spawn in the area from Durham to the Parrott-Phelan Dam, although some are known to spawn above these dams. Spawning generally occurs from October through December. Fall-run fry begin to emigrate during January and February, and smolts emigrate during April and May. However, many juveniles are entrained at the diversions or perish because of poor water quality.

Although little is known about steelhead in Butte Creek, adults probably ascend in the late fall and winter. They probably spawn during winter and spring in tributaries, such as Dry Creek, and the mainstem creek above Parrott-Phelan diversion.

The water allocation problems in the lower Butte Creek system need to be reduced. The diversion of water for agriculture, waterfowl refuges, and seasonally flooded wetlands should not impair efforts to rebuild salmon and steelhead stocks. Butte Creek water management is extremely complex. Maintaining adequate fishery flows will require close coordination among all water users in the basin. Extension of State Watermaster Service into the lower reach of Butte Creek should be considered to fulfill these management goals. This extension, however, requires the State Water Resources Control Board to adjudicate water below the Western Canal siphon. The area above is adjudicated. State Watermaster Service presently exists down to Western Canal. Extension of this service below Western Canal would require adjudication of the remaining water rights. Wildlife refuges and hunting clubs dependent on Butte Creek water provide some of the most valuable wildlife and waterfowl habitat in the Sacramento Valley. The timing of water needs conflicts among duck clubs, agriculture, and the anadromous fisheries .

Seasonal flooding of refuges and duck clubs conflicts with flows needed for spawning fall-run chinook salmon. Rice field irrigation overlaps with the need for transportation flows for both spring-run adults and juvenile salmon in April and May. Evaluating and determining water rights, water use, and instream flow needs will be a long-term effort requiring the involvement of irrigation districts,